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IV. THE AMERICAN REPRESENTATIVES OF *ASPLENIUM* *RUTA-MURARIA*

It has been repeatedly remarked by American students of ferns that, whereas *Asplenium Ruta-muraria* L. of Europe acquired its name from its common habitat, the plant of North America is rarely, if ever, found on brick- or stone-walls. European botanists are essentially unanimous as to the habitat of their plant. Thus, more than a century ago, the great student of the ferns, Schkuhr, stated it: "Hab. ad muros et in fissuris rupium";¹ and later authors give the following statements. Moore: "on rocks and on ruins, and in abundance on old walls";² Hooker: "Common on rocks and old walls and buildings";³ Lowe: "Delighting to grow on old walls, both brick and stone, and more especially on the northern side, and preferring to mount up the walls as high as possible";⁴ Britten: "The name is an apt one, . . . although not confined to walls, it is essentially a wall plant";⁵ Christ: "In bewohnten Europa ist die Art von dem anstehenden Fels und den grössern Blöcken auf die Mauern, sowohl die rohen Trockenmauern der Strassenborde und Kulturterrassen, als auf die ältern, mit Mörtel verbundenen Mauern gewandert, sodass wohl im ganzen solche künstliche Standorte vorwiegen; daher

¹ Schkuhr, Krypt. Gewächse, 75 (1809); rupium misprinted "pupium."

² Moore, Nat. Printed Brit. Fern. oct. ed ii. 121 (1860).

³ Hooker, Brit. Ferns, t. 28 (1861).

⁴ Lowe, Our Native Ferns, ii. 222 (1867).

⁵ Britten, Eur. Ferns, 111 (1881).

der Name";¹ Druery: "common on old walls, bridges, etc. . . . almost invariably rooted in old mortar."² Contrasted with these typical statements of the European habitat we have in America, such statements as the following. Torrey: "Limestone rocks, usually in shady situations: rare";³ D. C. Eaton: "clefts of calcareous rocks . . . but not seen on walls in America";⁴ Clute: "It loves the sheltered nooks on dry cliffs";⁵ Waters: "It grows on sunny, exposed cliffs, or boulders";⁶ Slosson: "Seams, pockets, and ledges of calcareous rock: usually exposed to sun or in partial shade."⁷ From these characteristic statements it would appear that the plant of eastern America is a conservative and comparatively rare fern, that of Europe an aggressive and common type.

The ranges of the Eurasian and the American plants are also strikingly contrasted. *Asplenium Ruta-muraria*, according to the late James Britten, is "found in most parts of the United Kingdom [Great Britain and Ireland]"; thence "It extends throughout Europe, from Norway to Spain and Portugal, Italy, the Mediterranean Islands, Greece, and Turkey. It is found both in North and South Africa, and in many parts of Asia, from the Ural Mountains to Thibet and Kashmir,"⁸ etc. Christensen, however, cuts out the South African occurrence and says merely: "Europa. Asia septentr.—Himalaya. U. S. A. orient."⁹ but he has subsequently cited it from southwestern China near the Thibetan border.¹⁰ Ledebour¹¹ does not cite it from east of Lake Baikal and it is apparently not found in extreme eastern Asia.¹² The American plant occurs from Vermont to southern Ontario, south to Alabama and Arkansas; *i. e.* it has an Alleghenian range.

Long experience has shown that the Alleghenian flora is to a great extent made up of ancient species, with their nearest affinities in Japan or adjacent continental eastern Asia, rather than in western

¹ Christ, *Die Varietäten und Verwandten des Asplenium Ruta muraria L.*, Hedwigia, xlii. 155 (1903).

² Druery, Brit. Ferns, 76 (1910).

³ Torr. Fl. N. Y. ii. 492 (1843).

⁴ D. C. Eaton, Ferns N. A. i. 108 (1879).

⁵ Clute, Our Ferns in their Haunts, 162 (1901).

⁶ Waters, Ferns, 157 (1903).

⁷ Slosson, How Ferns Grow, 28 (1906).

⁸ Britten, l. c. 112 (1881).

⁹ C. Christens. Ind. Fil. fasc. iii. 130 (1905).

¹⁰ C. Christens. Acta Hort. Gothob. i. 80 (1924).

¹¹ Ledebour, Fl. Ross. iv. 520 (1852-3).

¹² It has been recorded as very rare in Japan, but neither Christ nor Christensen admit it from there.

Eurasia. Consequently, it would be most unusual for a rare or conservative plant, which in America is unknown north of Vermont and southern Ontario, to be common in Europe but rare or quite unknown in eastern Asia. Furthermore, it is quite contrary to our ordinary experience, that a local and non-aggressive Alleghenian species should in Europe be a common plant, there taking possession of the artificial walls built by man: roadside- and garden-walls, the mortar of brick or stone buildings, bridges, and even church-steeple. There are plenty (more than a thousand) of cases of youthful and aggressive European plants introduced into temperate eastern America and quickly overrunning the region; but, with the exception of the calcicolous aquatic, *Elodea canadensis*, conservative plants of temperate eastern America have rarely, if ever, shown pioneering tendencies in Europe.

From these considerations it would be surprising if the common European *Asplenium Ruta-muraria* and the rare fern of Alleghenian America are really identical. Nevertheless, I can find little indication in literature that they have even been suspected of being different. Most students of the ferns, Hooker, Moore, Mettenius, Luerssen, Milde, D. C. Eaton, Underwood, Slosson, Christensen and many others, seem to have regarded them as strictly identical; and some have even made positive assertions of the identity. Thus, Torrey, in 1843, said of the American fern: "In all respects similar to the European plant, except that it is usually smaller";¹ and Christ,² making a detailed study of the variations of the species, recognized no less than 17 varieties and subvarieties in Europe and identified with 4 of these European varieties the plants of eastern America. Very rarely a mild suggestion of a difference has been voiced. Thus, Michaux made the "*Obs. Europaeo multo minus*";³ Pursh, similarly said: "The American plant is very small, scarcely ever exceeding an inch or two in height";⁴ and Torrey's comment to the same effect has just been quoted. But since Torrey, apparently no one has commented even on the difference of size.

When the two series are carefully measured, however, the accuracy of the observations of Michaux, Pursh and Torrey becomes quite evident. I have studied 154 plants of the European series, with an

¹ Torr. l. c. 492 (1843).

² Christ, l. c. (1903).

³ Michx. Fl. Bor.-Am. ii. 266 (1803).

⁴ Pursh, Fl. Am. Sept. ii, 667 (1814).

average of 10 or 12 fronds each, and 290 plants of the American series, with an average of 6 or 8 fronds each. Measurements of stipe and frond and count of segments give the following results: the stipes of the European plant range from 1.8–15 cm. long, with an average length of 7 cm., of the American series 1–7.5 cm. with an average length of 4.5 cm.; the fronds of the European plant range from 1.5–7.5 cm. in length, with an average of 4 cm., those of the American plant from 1–6.5, with an average of 3.3. cm.; the largest fronds of each collection show in the European 7–60 segments (average 33) in the American 3–42 (av. 15). The difference of size noted by Michaux, Pursh and Torrey is, thus, very real.

But the differences are not limited to size. In European *Asplenium Ruta-muraria* the teeth of the segments are commonly bordered by a whitish cartilaginous rim which is frequently prolonged into a minute tip, and the mature sori become so confluent that their boundaries are quite obscured. In the American plant the teeth of the segments are coarser than is usual in the European and the cartilaginous border is only slightly, if at all, developed; and the mature sori are rarely completely confluent.

In the European plant the chaffy tips of the rhizomes and the chaffy bases of the stipes project above the root-bearing region of the short and thick rhizome and are easily seen under a low-power lens; in the American the tips of the rhizome and the chaffy stipe-bases are hidden among the rootlets of the elongate rhizome and can be seen only by dissecting away rootlets and marcescent old stipe-bases. This really important difference of the rhizomes has been beautifully shown, but apparently quite unappreciated, in some of the best illustrations. It is well displayed in such European illustrations as those of Schkuhr,¹ Lowe,² Britten³ and Druery⁴ and in the American plates of John Robinson,⁵ Williamson,⁶ D. C. Eaton⁷ and Tilton.⁸

When the basal chaff is examined it will be found that the scales of the European *Asplenium Ruta-muraria* are 3–6 mm. long, made up of a lattice-like frame with whitish lumina, the broadest part of the scale with usually 6–9 rows of cells, the cell-walls much thinner than

¹ Schkuhr, l. c. t. 80b (1809).

² Lowe, *Our Native Ferns*, ii. t. xlvi. (1869).

³ Britten, l. c. figs. on pp. 111 (copied from Gerarde's Herbal) and 112 (1881).

⁴ Druery, *Brit. Ferns and Vars.* t. v. (1910).

⁵ J. Robinson, *Ferns in their Homes and Ours*, t. xvi. (1878).

⁶ Williamson, *Ferns of Ky.* t. xix. (1878); *Fern Etchings*, t. xxiv. (1879).

⁷ D. C. Eaton, l. c. t. xv. fig. 1 (1879).

⁸ Tilton, *Fern Lover's Comp.* 89 (1922).

the broad lumina; while the basal scales of the American plants are shorter and firmer, 1.5–4 mm. long, with fewer rows of cells, the cell-walls as thick as the lumina. In the European plant the stipe usually bears slender curving trichomes or linear-filiform scales 1–3 mm. long; in the American series the stipe is quite naked or only rarely with a few short trichomes.

The indusia of the two plants are so similar as to present no quickly recognized differences, but, as already noted, the sori of the American are rarely as confluent as in the European. The spores are of practically the same size; but, whereas those of the European plant are marked with coarse irregular ridges, the spores of the American have a much finer sculpturing.

From this analysis it is apparent that Eurasian *Asplenium Ruta-muraria* is in its behavior and its technical details quite different from the Alleghenian plant which for a century and a quarter has been confused with it. It is, therefore, proper to separate the Alleghenian species as

ASPLENIUM cryptolepis, n. sp., ab *A. Ruta-muraria* recedit rhizomate elongato apicibus radiculis basibusque stipitium marcescentibus vestito; stipitibus 1–6.5 (medio 4.5) cm. longis ad basin squamis setiformibus paucis instructis supra plerumque esquamosis; squamis basilaribus firmis lanceolatis 1.5–4 mm. longis loco latissimo cellulis 3–6-seriatis, parietibus cellularum crassis diametro luminum subaequantibus; lamina deltoidea vel deltoideo-ovata 1–6.5 (medio 3.3) cm. longa subcoriacea; segmentis 3–42 (medio 15) cuneato-rhombeis grosse dentatis, dentibus deltoideis vel oblongis obtusis vel subacutis margine plerumque vix hyalino; soris distinctis vel subconfluentibus; sporis minute rugulosis.—*A. Ruta-muraria* of Am. authors, not L.—Calcareous cliffs and ledges, rare and local, Vermont to southern Ontario, south to Alabama and Arkansas. The following, selected from many specimens, are typical. VERMONT: North Willoughby Cliff, July 14, 1887, *Faxon*; dry limestone ledge, Milton, August 6, 1924, *C. H. Knowlton*; Winooski Gorge, Colchester, *Blake*, no. 2153; Sharpshin Point, Burlington, October 3, 1857, *Wm. Boott*; Burlington Bay, July 7, 1909, *Kirk*; High Bridge, Winooski, August 7, 1877 and June 14, 1881, *Faxon*; Shelburne Bay, September 29, 1855, *Wm. Boott*; Mt. Philo, Charlotte, September 9, 1881, *Faxon*; Snake Mt., Addison, June 31, 1896, *Eggleston*; Pittsford, *Slosson*; Clarendon Gorge, August 27, 1897, *G. H. Ross*; rocks, Dorset, 1915, *E. H. Terry*; Mt. Aeolus, East Dorset, August 29, 1897, *Eggleston*; limestone ledges in hillside pasture, East Dorset, July 24, 1907, *G. G. Kennedy*; Manchester, *M. A. Day*, no. 253; cliffs, North Pownal, July 25, 1898, *Eggleston*; August 1, 1898, *Churchill*; crevices of ledges, usually in half-shade, The Cliff, North Pownal, June 22, 1901, *F. G.*

Floyd; with *Camptosorus*, Gregor Rocks, North Pownal, August 12, 1902, *Blanchard*. MASSACHUSETTS: Mt. Toby, Sunderland, August 10, 1871, *L. B. Tuckerman*, and later collections by *Bishop, Jesup et al*; rocky hill, Stockbridge, June 27, 1900, *Ralph Hoffmann*; shaded limestone ledges, Sheffield, July 6, 1906, *Bissell* (TYPE in Gray Herb.); lime ledge, Sheffield, June 1, and September 30, 1919, *Churchill*. CONNECTICUT: lime ledges, Canaan, August 14, 1912 and October 28, 1916, *F. G. Floyd*; shaded limestone ledges, Salisbury, September 22, 1903, *Bissell*; ledges, Miles Mt., Salisbury, October 19, 1916, *F. G. Floyd*; calcareous rocks by Housatonic River, Kent, *Austin & Eames*, no. 4059; Bull's Falls, above Gaylordsville, July 28, 1889, *I. Holden*; dry calcareous rocks, Gaylordsville, *Austin & Eames*, no. 8308; moist shaded limestone ledge by Housatonic River, New Milford, *A. E. Blewitt*, no. 1205; dry limestone on shaded bank of Housatonic, New Milford, *Austin & Eames*, no. 8308. NEW YORK: Poughkeepsie, *Van Gieson*; Little Falls, *Vasey*; Jamesville, July, 1885, *Hulst*. NEW JERSEY: vicinity of Newton, *Dowell*, no. 4816; limestone rocks, Sussex Co., 1867, *Austin*. PENNSYLVANIA: Wilkesbarre, 1867, *H. Coultas*; Easton, *Traill Green*; Bushkill Creek, Northampton Co., *L. M. Stevens*; along Mill Creek, near Lancaster, July 15, 1890, *Small*; limestone cliffs, Centre Co., *Tuttle & Rothrock*. VIRGINIA: at 365-460 m. (1200-1500 ft.), Mt. Crawford, Rockingham Co., *Heller*, no. 785; Natural Bridge, May 30, 1891, *Churchill*, and at later dates by *Kennedy, T. O. Fuller et al*; Wythe Co., June 7, 1872, *A. H. Curtiss*. WEST VIRGINIA: Harper's Ferry, *B. D. Greene*; shaded limestone bluff by Shenandoah R., Jefferson Co., September 9, 1899, *Wm. Palmer*. NORTH CAROLINA: on ledges at 1220 m. (4000 ft.), Pilot Mt., July 4, 1915, *P. O. Schallert*. ONTARIO: north end of Manitoulin Island, Georgian Bay, *Scott* in herb. Geol. Surv. Can. no. 66,415. MICHIGAN: without locality, *State Collection*. INDIANA: limestone, Jefferson Co., 1872, *J. Hussey*. TENNESSEE: on rocks along Tennessee R., Knoxville, *Ruth*, no. 556; Holston River, below Concord, July, 1872, *W. Faxon*; Post Oak Springs, Roane Co., *Pollard & Maxon*, no. 412. MISSOURI: calcareous rocks, near Lott's Mills, Perry Co., November 15, 1886, *C. H. Demetrio*; wet mossy rocks, Shannon Co., *Bush*, no. 436; on boulders in woods, Montier, *Bush*, no. 2795; shaded limestone rocks, near Montier, *E. J. Palmer*, no. 19,343.

ILLUSTRATIONS (as *A. Ruta-muraria*): *J. Robinson*, *Ferns in their Homes and Ours*, t. xvi. (1878); *Williamson*, *Ferns of Ky.* t. xix. (1878) and *Fern Etchings*, t. xxiv. (1879); *D. C. Eaton*, *Ferns N. A.* i. t. xv. fig. 1 (1879); *Tilton*, *Fern Lover's Comp.* 89 (1922).

European *Asplenium Ruta-muraria* is so variable that many varieties have been proposed, *Milde* recognizing 10, *Christ* 17. *A. cryptolepis*, on the other hand, is a tolerably constant plant. The fronds of young or small individuals have fewer and more dilated segments than in the older or larger plants but such variation is found in the

individual colonies and is of no taxonomic importance. In one area, however, the limestone cliffs of Clifton Gorge, of the Little Miami River in Greene County, Ohio, the plant has so far departed from typical *A. cryptolepis* that it may well be designated as a geographic variety. The six different collections before me are constant in having lanceolate segments with long-attenuate tips and incised margins. This extreme may be called

A. CRYPTOLEPIS, var. **ohionis**, n. var., segmentis lanceolatis incisiss apice longe attenuatis.—OHIO: Springfield, *T. G. Lea*; Clifton, Greene County, 1873, *J. Y. Bergen, Jr.*; limestone rocks, Yellow Springs, Greene Co., August 3, 1902, June 15, 1905, *L. S. Hopkins* (TYPE in Gray Herb.); on Niagara limestone, Clifton Gorge, Little Miami River, August 22, 1920, *Clara G. Mark*.

Of this Ohio variety, Mr. L. S. Hopkins wrote, in 1907:

“The single station known for it is in Greene County, and at the present time numbers approximately one hundred plants whose short stiff rootstocks find solid footing in the cracks and crevices of a western exposure of Niagara Limestone. No other fern with which I am acquainted is so exacting in its choice of a home. This station has been under my observation for several years, and quite a number of plants have been collected from it. Just around a corner and not over five feet from the place where strong, vigorous plants grow, not a single plant has been found on a southern exposure of the same material and ecological conditions.”—L. S. Hopkins, *Fern. Bull.* xv. 6 (1907).

That the plants of var. *ohionis* have been more numerous is indicated by the collections of *Lea* and of *Bergen* (two different collections) and by the fact that material of it has been widely distributed to different herbaria. Such a specimen, collected at Clifton in 1877 by G. E. J. Spencer, was the basis of the erroneous identification by Christ¹ of the Ohio plant with the European *A. Ruta-muraria*, var. *lanceolum* Christ—the European plant, as shown in Christ's plate, having the numerous (42–54) segments of *A. Ruta-muraria*, with their teeth few and small or obsolete, *A. cryptolepis*, var. *ohionis* having the few (5–28) segments and other characters of *A. cryptolepis*, but with elongate tips and incised margins.

¹ Christ, *Hedwigia*, xlii. 171 (1903).